



Range-Correction And Convective-Stratiform Separation Algorithms

Presentation to the NEXRAD Technical Advisory Committee

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Purposes of RCA/CSSA

- Range Correction Algorithm (RCA)
 - Mitigate rainfall overestimation associated with bright band
 - Mitigate rainfall underestimation at longer ranges
- Convective-Stratiform Separation Algorithm (CSSA)
 - Identify areas of shallow and deep convective precipitation
 - Data from convective zones is excluded from RCA adjustment



Operational Needs

- Cool-season radar rainfall estimates often feature bright-band and range-degradation features that affect operational precipitation analyses used in hydrologic forecasting, hydrologic model calibration, parameter estimation
- Mosaic algorithms and local gauge corrections are often inadequate to mitigate these artifacts
- Statement of Need from OS&T and OCCWS in June 2003
- NEXRAD Active Technical Needs: TAC TN-10



Today's Topics

- Brief explanation of RCA logic
- Brief explanation of CSSA logic
- Illustration of RCA effects on rainfall estimates
- Comparative verification statistics with and without RCA/CSSA
- Real-time field evaluation (underway)



RCA logic

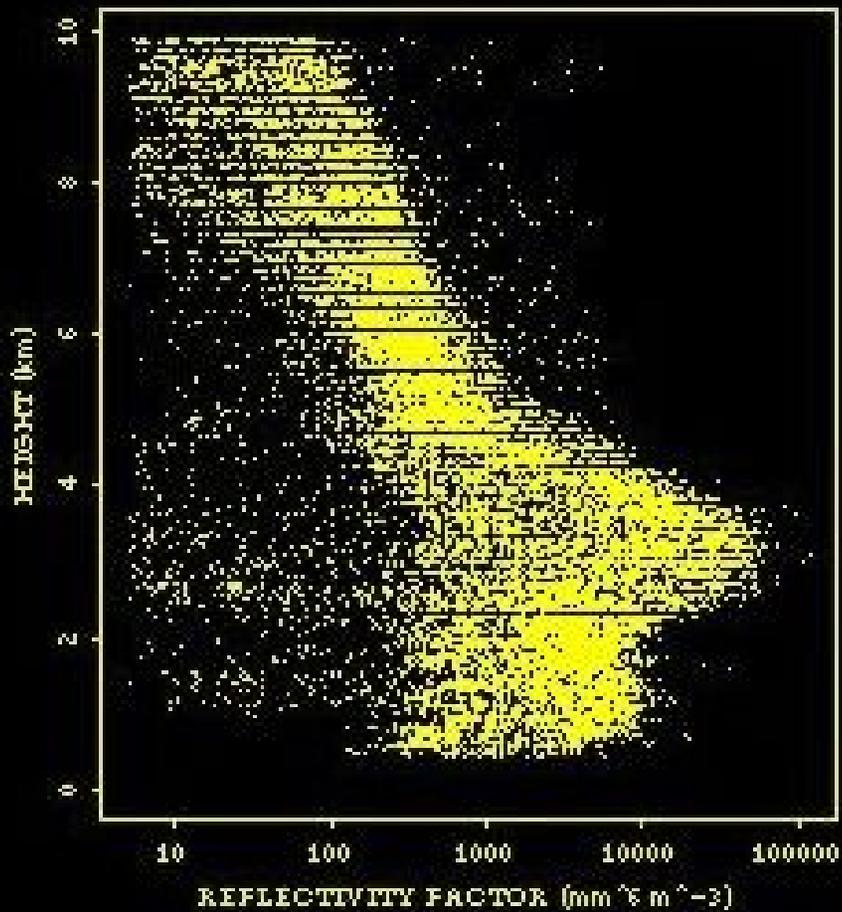
- Construct areal-mean Vertical Profile of Reflectivity (VPR) from latest volume scan, using data close to radar
- Use VPR to estimate near-surface reflectivity at ranges where lowest radar beam intersects melting layer, snow, or differing hydrometeor distribution aloft



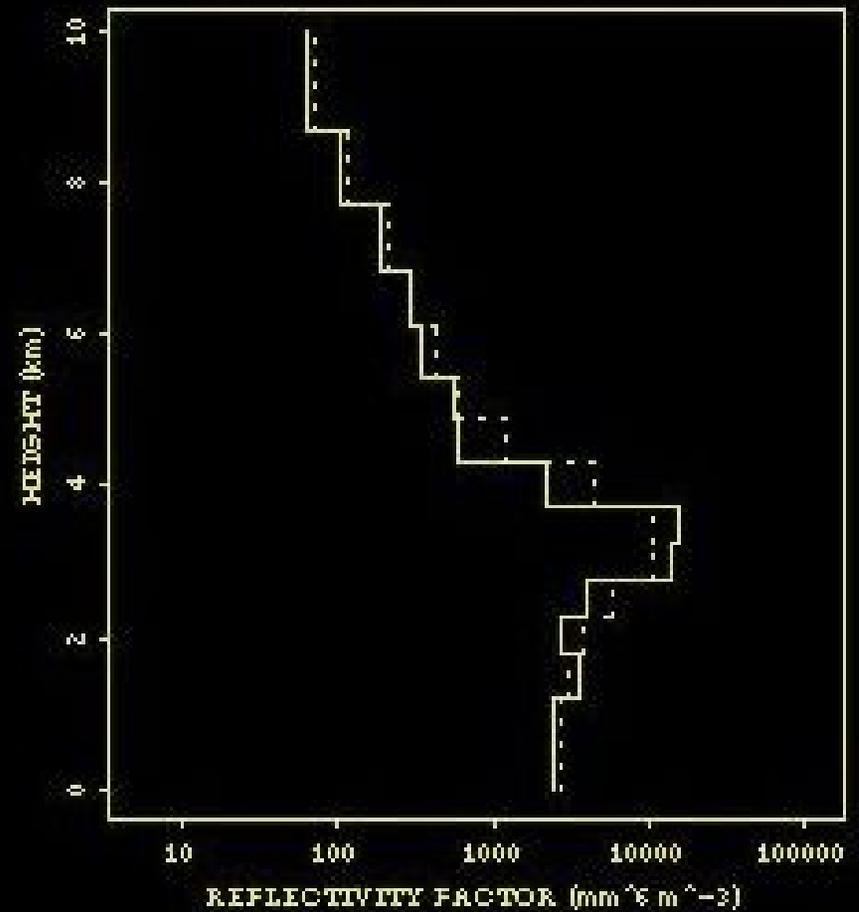
Technical References

- Seo, D.-J., Breidenbach, J., Fulton, R., Miller, D., O'Bannon, T. 2000: Real-Time Adjustment of Range-Dependent Biases in WSR-88D Rainfall Estimates due to Nonuniform Vertical Profile of Reflectivity. *J Hydrometeorology*, **1**, 222–240.
- Vignal, B., G. Galli, J. Joss, and U. Germann, 2001: Three Methods to Determine Profiles of Reflectivity from Volumetric Radar Data to Correct Precipitation Estimates. *J. Appl. Meteor.*, **39**, 1715-1726.
- Vignal, Bertrand, Krajewski, Witold F. 2001: Large-Sample Evaluation of Two Methods to Correct Range-Dependent Error for WSR-88D Rainfall Estimates. *J. Hydrometeorology*, **2**, 490–504.

Point reflectivity observations

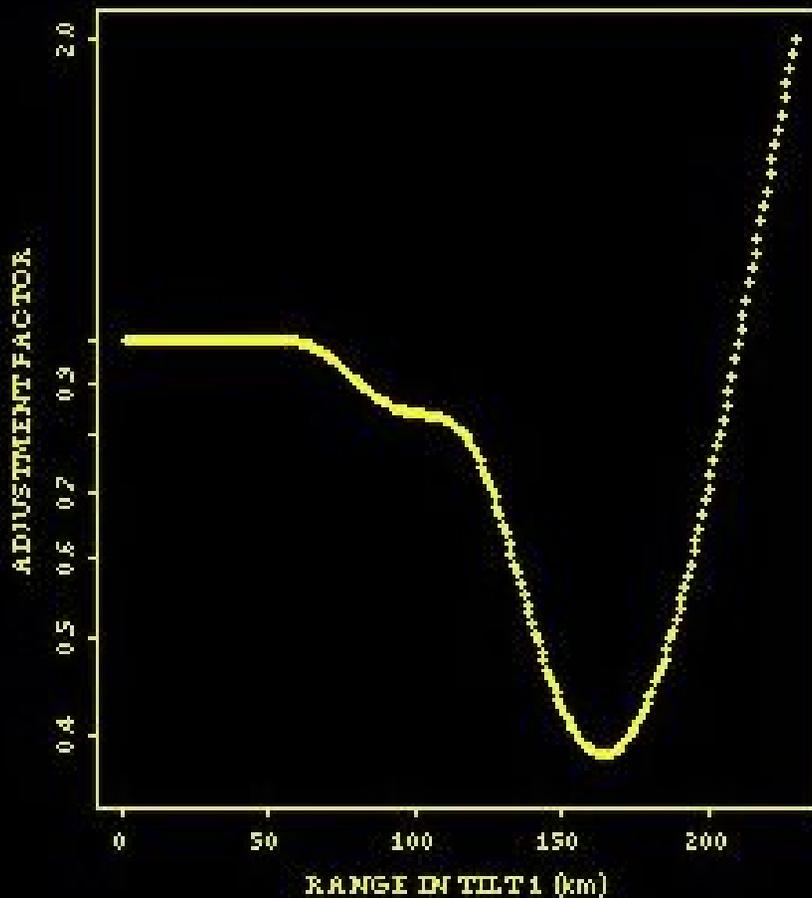


Mean VPR

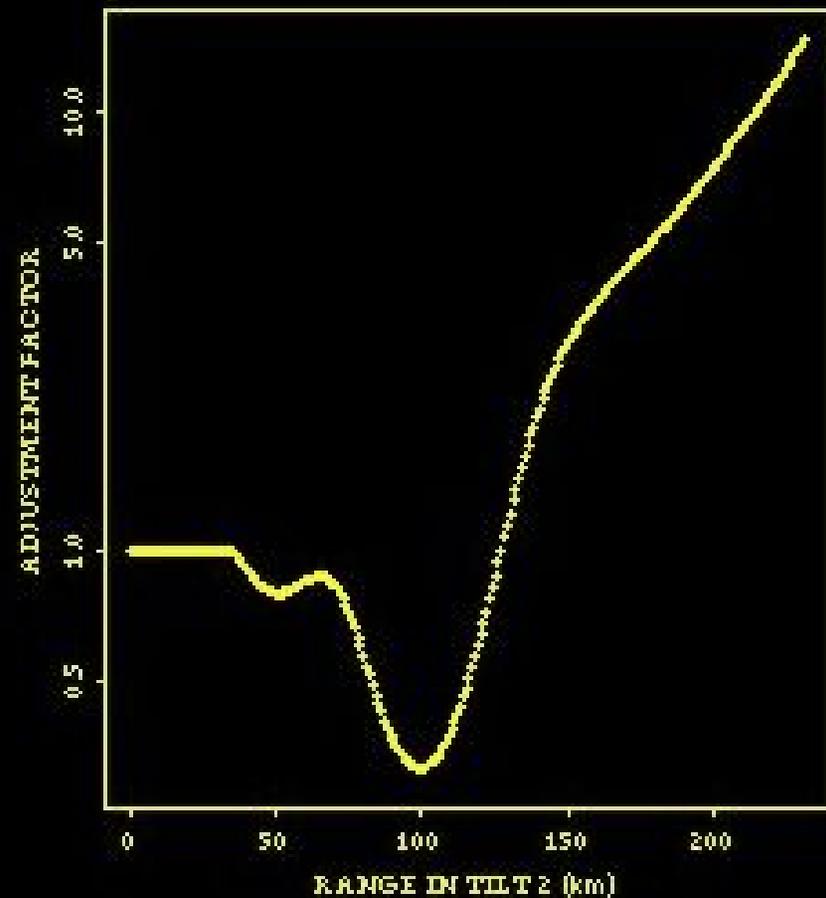


Reflectivity Adjustment Curves based on VPR

For 0.5° Tilt



For 1.5° Tilt



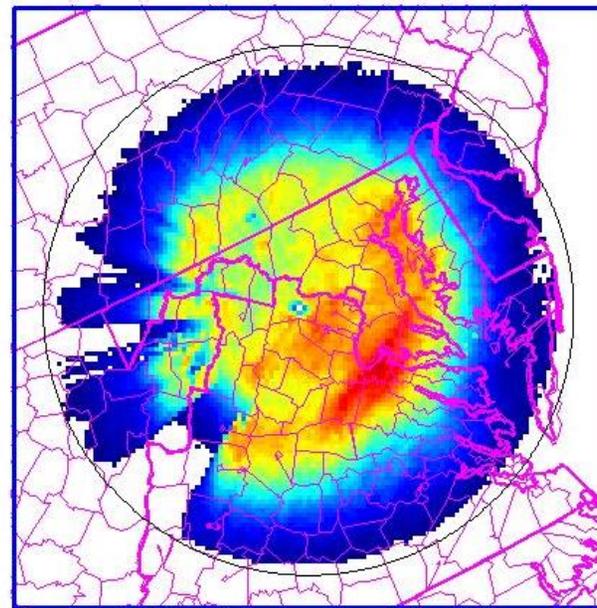
Original accumulation:
February 2003
(From DPA products)

Bright-band evident in north-central
Virginia, central Maryland

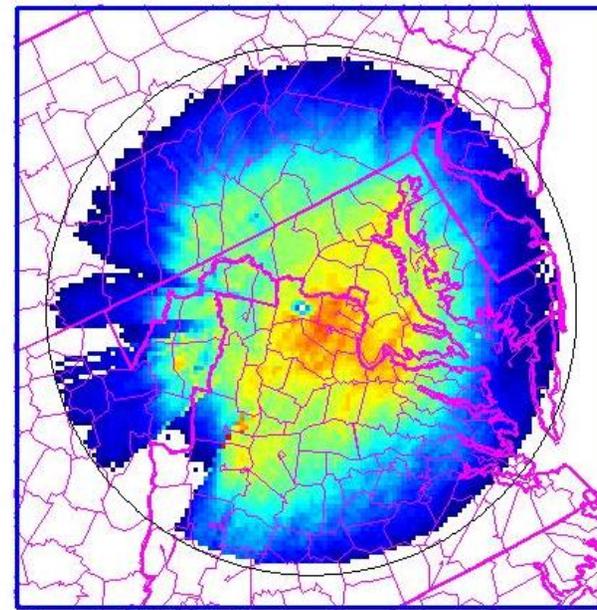
Accumulation with range
adjustment:

Bright-band effect mitigated;
Larger accumulations at long ranges

a. Original

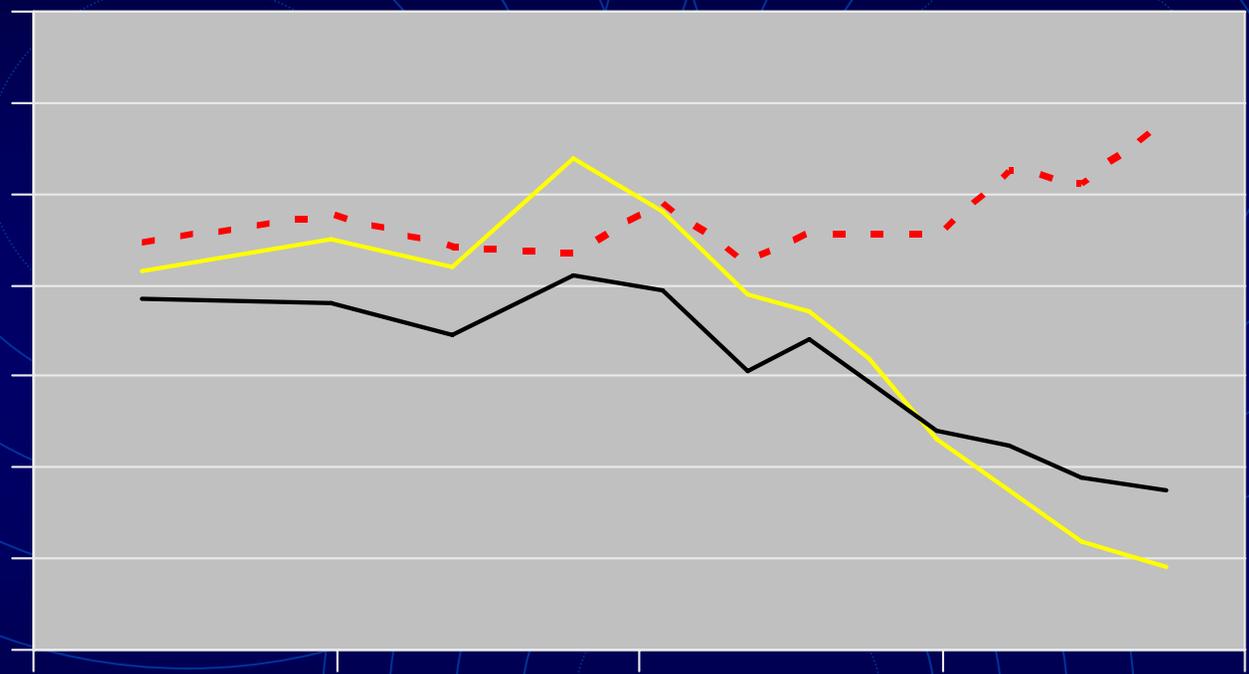


b. RCA-adjusted



Azimuthal Mean Precipitation As Function of Range

FEBRUARY-MAY 2003, KLWX



Range (km)



Verification Statistics vs. 24-h Gauge Reports

FEBRUARY-MAY 2003, KLWX

7500 24-h gauge reports with radar precipitation > 0

Mean gauge amount: 9.5 mm

| | RMSE | Rank | Reduction |
|-----|------------|-------------|-------------|
| | Gage/radar | Correlation | of Variance |
| DPA | 9.8 mm | 0.53 | 0.28 |
| RCA | 9.3 mm | 0.62 | 0.36 |



RCA limitations

- Use of mean-field VPR is justified only when it is representative of entire umbrella
- Cannot apply when freezing level is very close to ground
- Does not extend effective detection range of radar
- Can be affected by non-precipitation echoes (clutter, insects)
- CPU usage being investigated

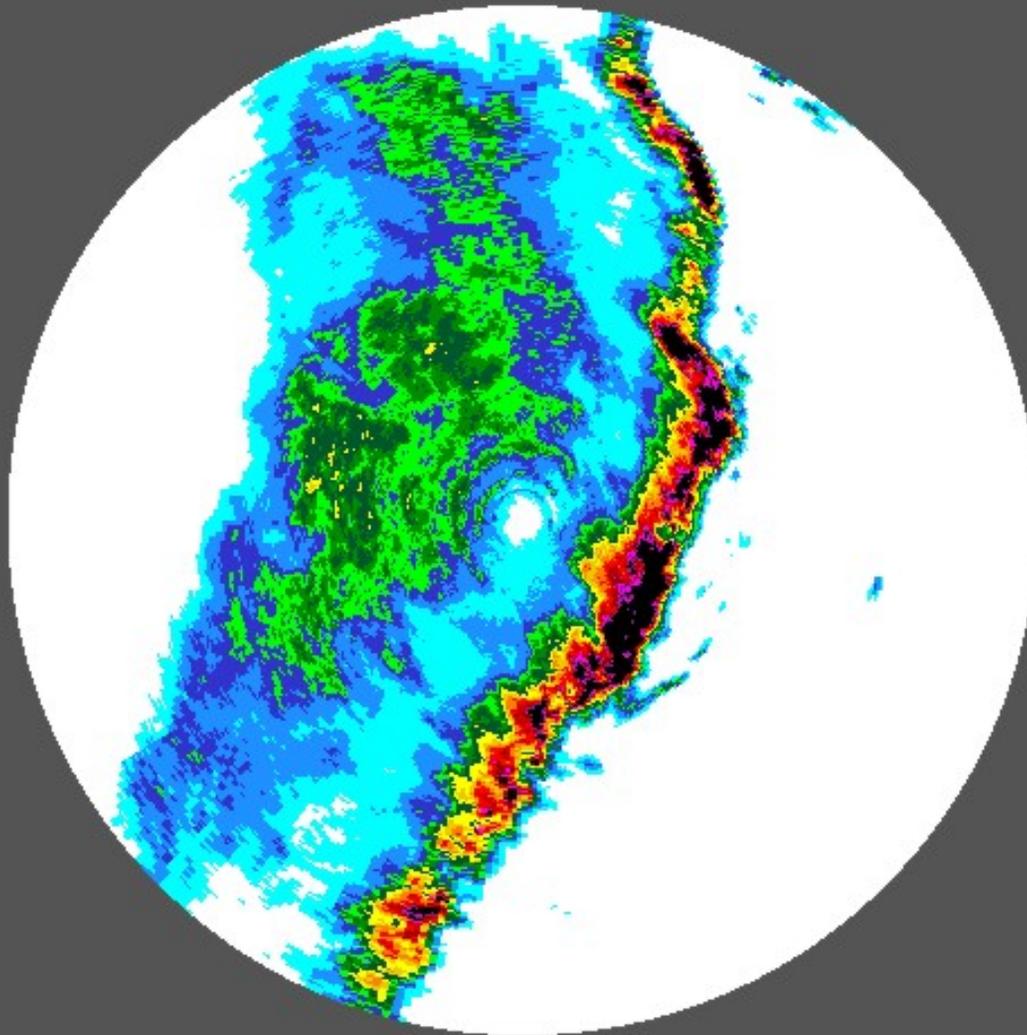


Convective-Stratiform Separation Algorithm

- Examines 3-D reflectivity morphology to assess probability that precipitation is convective
- Logic based on maximum reflectivity, horizontal and vertical correlation of reflectivity, vertically-integrated liquid
- Detects relatively shallow as well as deep penetrating convection
- Described in OHD/ROC reports for 2002, 2003 (<http://www.weather.gov/oh/hrl/papers/papers.htm#wsr88d>)

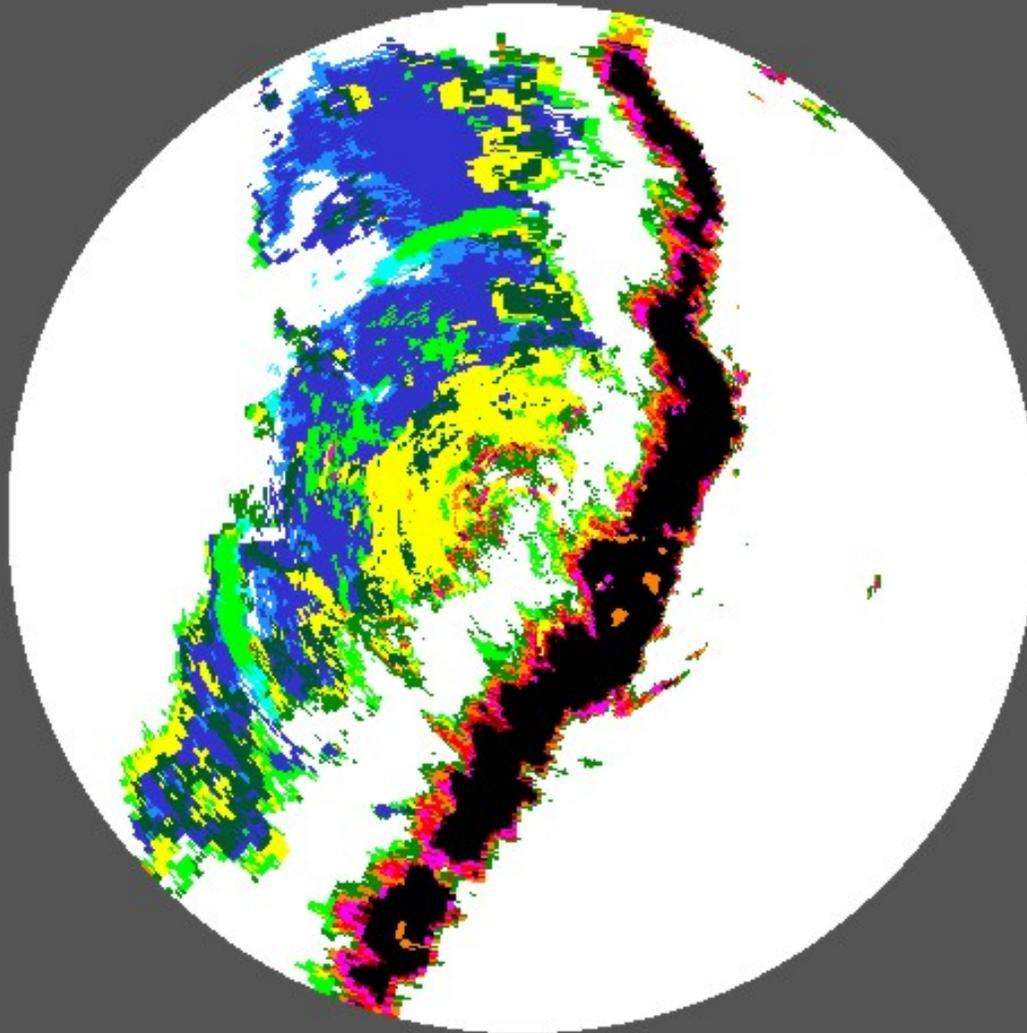
Vertically-Integrated Liquid

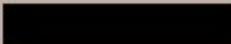
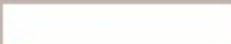
Site: KINX



Convective Probability

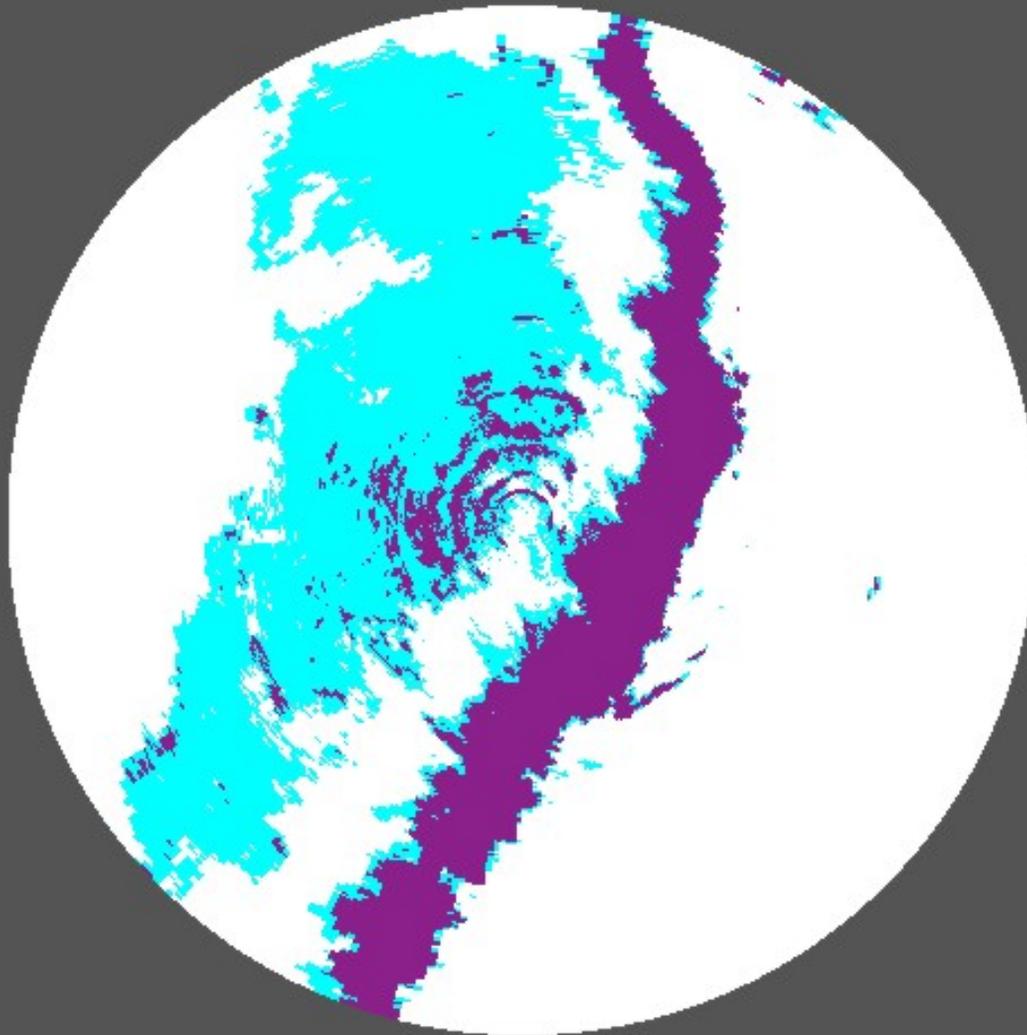
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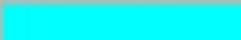


| | |
|---|---------|
| Next | |
| Next Low | |
| Quit | |
| Prob[bin in the convective core] | |
|  | < 0.000 |
|  | < 0.100 |
|  | < 0.200 |
|  | < 0.300 |
|  | < 0.400 |
|  | < 0.500 |
|  | < 0.600 |
|  | < 0.690 |
|  | < 0.810 |
|  | < 0.830 |
|  | < 0.870 |
|  | < 0.890 |
|  | < 0.920 |
|  | < 0.930 |
|  | < 0.950 |
|  | < 0.980 |
|  | < 1.000 |

Convective Classification

Site: KINX



| Next | |
|---|----------|
| Next Low | |
| Quit | |
| Prob[bin in the convective core] | |
|  | < 0.100 |
|  | < 0.150 |
|  | < 0.200 |
|  | < 0.250 |
|  | < 0.300 |
|  | < 0.340 |
|  | < 0.400 |
|  | < 0.440 |
|  | < 0.500 |
|  | < 0.550 |
|  | < 0.600 |
|  | <= 0.640 |
|  | <= 0.690 |
|  | <= 0.750 |
|  | <= 0.800 |
|  | <= 0.850 |
|  | <= 0.890 |



CSSA and RCA

- CSSA is used to filter non-stratiform profiles from input to VPR estimate
- Range correction is not applied near zones judged to be convective (adjustment factor reset to 1 in these areas)



Real-time Field Evaluation

- Carried out for 6 sites, March-June 2004:
 - Portland OR (KRTX)
 - Twin Lakes OK (KTLX)
 - Minneapolis MN (KMPX)
 - Kansas City MO (KEAX)
 - Charleston WV (KRLX)
 - Pittsburgh PA (KPBZ)
- Associated WFO's and ABRFC, MBRFC
- All products generated at NWSH, communications via LDM
- Graphic product access via secure website



Key Decision Points

Present field evaluation report to TAC (email or VTC) early July 2004

Implementation Readiness Review (internal) July/August 2004

SREC presentation, Fall 2004